

***Elpiscladius* Harrison and Cranston, a new orthoclad
(Diptera: Chironomidae) in the Brillia-group
from South Africa**

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An extensive survey of South African larval and pupal Chironomidae has revealed a previously unknown taxon in the subfamily Orthoclaadiinae. The material comprises three pupal exuviae and one pupa containing a pharate adult male, the morphology of which is readily observable. *Elpiscladius capicola* Harrison & Cranston, **gen. et sp. nov.** is described and illustrated based on the pharate adult and pupal exuviae. The male hypopygium has a divided gonostylus, the eye has a dorsomedial extension, and the body is highly setose; evidently the new genus belongs to the Brillia-group of genera. Pupal morphology does not refute such a relationship, and phylogenetic analysis of the combined adult and pupal morphology indicates the new genus to be the sister group of *Austrobrillia* Freeman (*Euryhopsis* Oliver+*Eurycnemus* van der Wulp). Based on the phylogenetic position of *Elpiscladius* gen. nov., the as yet unknown larva is predicted to be either leaf- or wood-mining.

Keywords: Orthoclaadiinae, new genus, new species, systematics, biogeography.

INTRODUCTION

The distributions of Southern Hemisphere Chironomidae (Diptera) have been influential in studies of historical biogeography and ecology, including reconstructions of past environments (e.g. Brundin 1966; Cranston 1994b).

The significance of South African chironomid distributions and their relationships to the biota of other southern continents was recognised by Freeman (1961: 613–614) and Brundin (1966: 452). Stemming from distributions on the southern land masses that comprised Gondwana in the Jurassic/Cretaceous, many modern distributions apparently retain the signal of their deep history. As illuminated, particularly by Brundin (1966), Gondwanan distributions are revealed in the subfamilies Podonominae and Aphroteniinae, and in the tribe Heptagyiini of the subfamily Diamesinae. Similar patterns are being revealed in the subfamilies Tanypodinae, Orthoclaadiinae and Chironominae. However, these patterns either preclude southern Africa, or if the region is included, their extralimital relationships often connect *via* the afro-montane and Rift Mountains to the Palearctic, rather than to other austral areas.

The writers have discovered independently a pharate male within a pupa (by A.D.H.), and pupal exuviae (cast skins) intercepted in drift (by P.S.C.), of a species evidently

belonging to the Brillia-group; a clade of Orthoclaadiinae rare in the Afrotropical Region. This taxon warrants description, even in the absence of larvae, adult females or emerged males. Thus, we describe here a pharate adult male retained within its pupal exuviae, and exuviae, all derived from the Western Cape Province of South Africa. An existing taxon-character matrix compiled to examine the relationships in the Brillia-group (Cranston 2000) is expanded upon to include this new South African genus, and parsimony analysis is applied to determine phylogenetic relationships.

MATERIAL AND METHODS

Ideally, associated larvae, pupae and female adult stages are preferred for full taxonomic descriptions; these have, however, proven highly elusive for this chironomid species. No candidate larvae recognisable as belonging to the Brillia-group have been identified amongst thousands of specimens examined by the first author. Fortuitous association of larval head capsule still attached to a pupa is rendered unlikely, given the paucity of pupal exuvial specimens encountered by the second author while drift-netting numerous 'suitable' streams in the Western Cape Province. It is decided, therefore, to present the description of this new taxon based on available stages only.

Standard morphological terminology and abbreviations follow Sæther (1980) and Cranston (1994a), with 'taenia' (adjective 'taeniate') used for the broadened pupal setae (Langton 1994). The term 'distolateral lobe' is preferred for the more distal gonocoxite lobe following Oliver's (1985) scepticism concerning homology with the inferior volsella. In the pupa, the conjunctive is numbered as belonging to the segment anterior to it. Unless otherwise indicated, measurements are in μm , generally rounded to the nearest $5\mu\text{m}$, except in cases where measurement at maximum magnification provided greater accuracy.

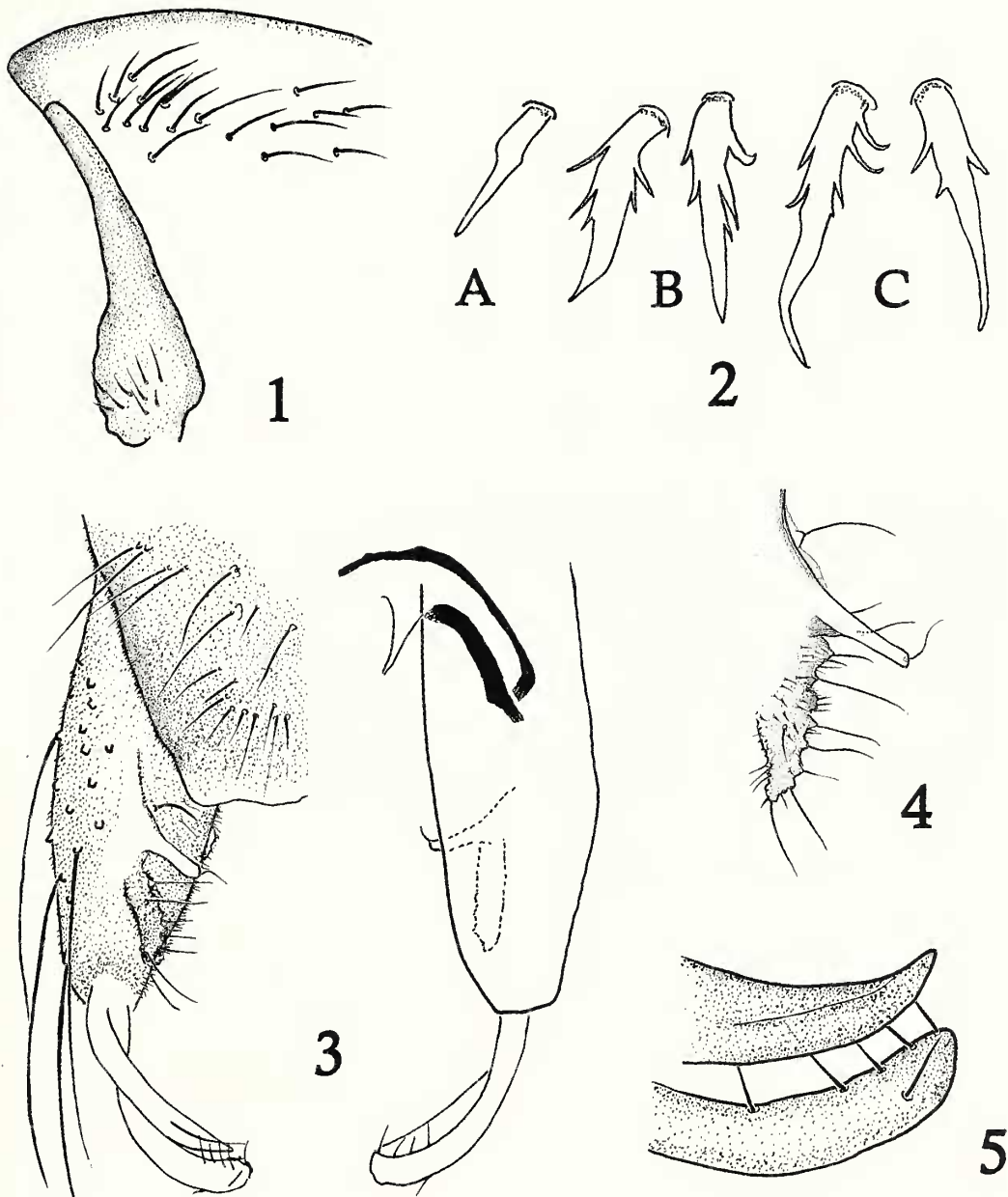
The holotype (pharate male) was mounted from 96% ethanol into Canada balsam dissolved in cellosolve, uncleared (by A.D.H.); exuviae were mounted from isopropanol in euparal (by P.S.C.). Material is housed in the Albany Museum, Grahamstown, South Africa (AMGS), the Natural History Museum, London, United Kingdom (BMNH), and the Australian National Insect Collection, CSIRO, Canberra City, Australia (ANIC).

SYSTEMATICS

ELPISCLADIUS HARRISON & CRANSTON, GEN. NOV.

Type-species: *Elpiscladius capicola* Harrison & Cranston, sp. nov., by monotypy.

DIAGNOSIS: The adult male of *Elpiscladius* gen. nov. is diagnosed by the attenuated



Figures 1–5. *Elpiscladius capicola* gen. et sp. nov. Adult male: 1, anterior thorax, lateral; 2, tibial spurs – A, fore, B, mid, C, hind; 3, hypopygium, left side dorsal, right side internal/ventral; (stylised) 4, superior volsella and distolateral lobe; 5, apices of gonostylus.

anteprenotal lobes, without dorsal anteprenotals, lack of pulvilli and tibial comb, in combination with a hypopygium without anal point, with bifid gonostylus lacking megasetae, and with a digitiform superior volsella. The pupa has frontal setae, spinose thoracic horn, hook row on tergite II, no taeniate L setae, spinose apical anal lobe, 3 macrosetae amongst a dense anal lobe fringe, and characteristic long seta on the anal lobe inner margin.

DESCRIPTION OF ADULT MALE: Antenna with 13 flagellomeres. Eye bare, with parallel-sided dorsomedian extension 7–8 facets deep. Palp 5-segmented, with segment 1 distinct, 4 and 5 subequal. Anteprenotal lobes widely-separated medially, narrow ventrally, with lateral anteprenotal setae only; scutum slightly overreaching anteprenotum. Acrostichals absent; dorsocentrals multiserial, long and numerous, beginning at anterior margin; few prealars; very long uni-biserial scutellars. Wing rather narrow, with minimal anal lobe, densely clothed in numerous fine macrotrichia, R-M apparently long and oblique, R₄₊₅ ending before wing margin; costa non-extended; squama with uniserial fringe. Legs with single spur on foretibia, with well developed tibial spurs on mid and hindlegs, spurs of each pair subequal in length, lateral spines diverging from shaft of spur, lacking hindtibial comb; claws simple and pointed, pulvilli absent. Hypopygium without anal point; transverse sternapodeme narrow, inverted U-shaped without projection or ridge; phallapodeme stout, with indication of median attachment to weakly sclerotised phallus, but lacking virga. Gonocoxite with two connected lobes, more anterior (superior) digitiform, medially-directed, non-microtrichiose, linked basally to caudally-directed setose and microtrichiose distolateral lobe. Gonostylus narrow and bifurcate, lobes of subequal length, setae few, only on apical lobe, lacking megaseta.

DESCRIPTION OF PUPA. Medium-sized, 4.4–7.2 mm long, pale yellow with slightly darker lateral and transverse apophyses.

Cephalothorax: frontal setae on weakly crenulate frontal apotome. Ocular field with 1 postorbital, without vertical seta. Thorax with 2 median anteprenotals (aps), 1 lateral aps, 3 subequal precorneals; 4 stout, equidistant dorsocentrals, Dc₄ longer than more spine-like Dc₁₋₃. Thoracic horn broadening to middle, apically pointed, with variable density and size of spinules covering at least apical half. Dorsal thorax smooth. Prealar area rectangular, bare. Wing sheath without pearl row.

Abdomen: Tergite I bare, TII–VI evenly spinulose, TVII and VIII with minor anterior spinulation. TII with uni-, weakly biserial hook row; conjunctives III and IV spinose in transverse multiserial band narrower than preceding tergal armature. Sternites anteriorly with fine transverse spinulation, plus stronger pleural stripes on IV. Pedes spurii A moderately developed on IV, weaker on V and VI. Anal lobe elongate oval, with

sparse anterior shagreen; fringe taeniae uniserial anteriorly, multiserial posteriorly, with 3 macrosetae inserted subapically, 1 long median seta. Apex of anal lobe beset with stout spines. Male genital sac very elongate tapering to rounded point, extending far beyond anal lobe apex, containing very elongate gonocoxal setae.

Abdominal setation: Segment I with 5D, 4V; 2L; segments II–VII with 5D, 4V; 4L, of which L4 is significantly postero-lateral; segment VIII with 1D, 1V and 5L, all longer and stouter than on more anterior segments, but none taeniate. Dorsal O-seta lie between transverse apodeme and conjunctive, ventral O-seta on transverse apodeme.

ETYMOLOGY: The generic epithet *Elpiscladius*, is derived from the Greek ‘*elpis*’ meaning ‘hope’, referring to the Cape of Good Hope.

***Elpiscladius capicola* Harrison & Cranston, sp. nov.**

MATERIAL EXAMINED: Holotype pharate male, SOUTH AFRICA, Western Cape, Betty’s Bay, Harold Porter Botanical Gardens, Davidskraal River, 34°20'50"S, 18°55'17"E, 29.i.1997, Denise Schael (AMGS, ABLDK.9C). Paratypes, 1 pupal exuviae, SOUTH AFRICA, Western Cape, Jonkershoek Nature Reserve, upper Eerste R., 33°59'38"S, 18°58'30"E, 22.xii.1996, P.S. Cranston (BMNH); 1 pupal exuviae, same except: 29.i.1998 (BMNH); 1 pupal exuviae, same except: 15.x.2005 (ANIC).

DESCRIPTION: [based on one well-developed pharate male and three pupal exuviae].

ADULT MALE ($n=1$, pharate within exuviae).

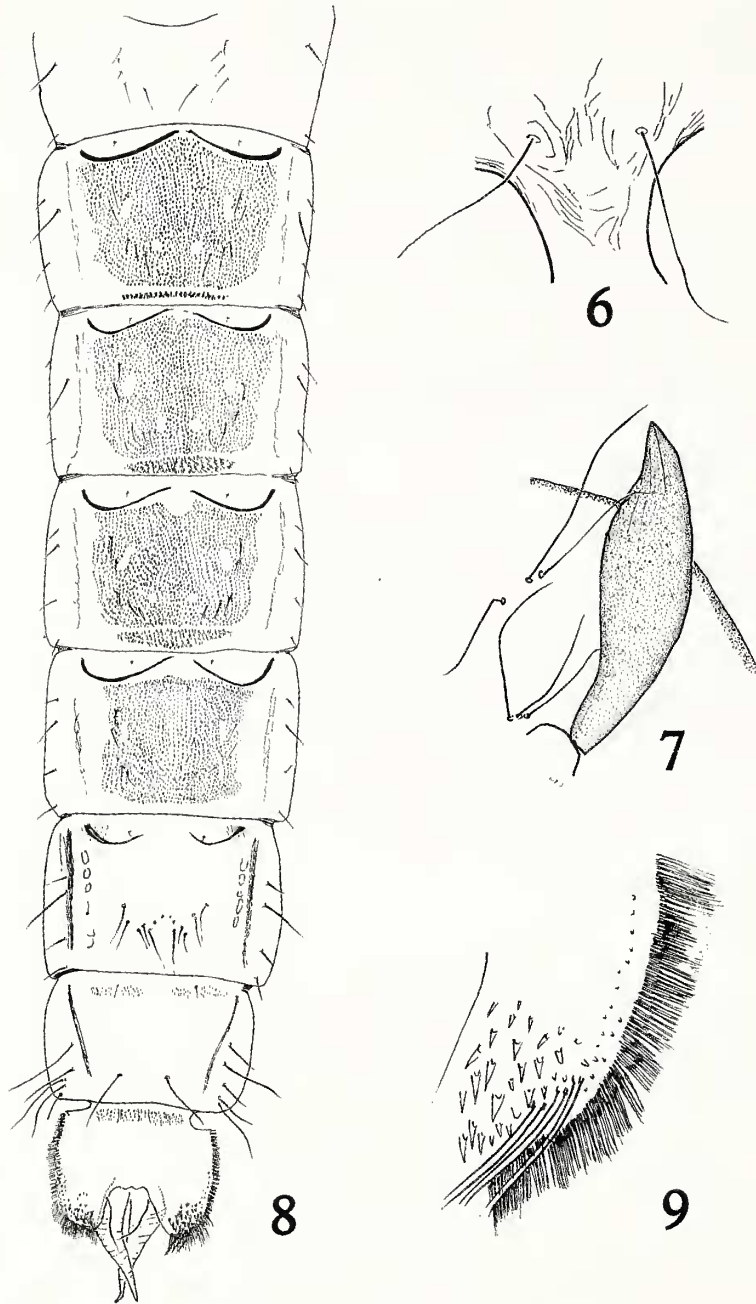
Body length: 4.2 mm.

Head: Antenna with 13 flagellomeres; basal flagellomeres c 35 long, apex of terminal flagellomere hidden by leg sheaths: AR incalculable. Eye bare with parallel-sided dorsal extension; temporal setae 16–18, more or less uniserial; palp with segment 1 distinct, lengths 20, 40, 76, 80, 95.

Thorax: Anteprenotal lobes widely separated (Figure 1), 8–9 lateral anteprenotals, no dorsal setae; anterior margin of scutum slightly overreaching anteprenotum. Acrostichals absent, c 50–56 long multiserial dorsocentrals, 8 prealars, supraalars not visible; 18 very long scutellars extending almost to posterior tip of postnotum (within exuviae).

Wing: Membrane densely clothed in short, fine setae. R_{4+5} apparently ending prior to wing margin, without costal extension. Squama with 16 setae.

Legs: Densely setose. Tarsomere 1 on each leg with longest setae 3–4 times tarsomere diameter. Spurs (Figure 2): foretibial 37 long, midtibiae 55, 60 long, hindtibiae 62, 74



Figures 6–9. *Elpiscladius capicola* gen. et sp. nov. Pupa: 6, cephalic area; 7, thoracic horn, antepronotals and precornicals; 8, abdominal tergites (anal lobe fringe attenuated); 9, anal lobe, detail.

long; mid and hind spurs with 2–3 lateral spines divergent from shaft, hind tibia lacking comb. Pseudospurs and sensilla chaetica absent, tarsomere 4 cylindrical and longer than tarsomere 5, claws simple and pointed, pulvilli absent.

Hypopygium (Figures 3–5). Tergite IX squat with numerous long setae, no anal point, virga absent. Apodemes as in Figure 3. Gonocoxite 205 long, almost parallel-sided, inner margin (Figure 4) bearing two lobes: superior volsella small and narrow with 1 ventro-medial, and 1 terminal seta; distolateral lobe microtrichiose and setose, arising appressed to base of superior volsella and inner gonostylus, distally free for at least half length. Gonostylus bilobed (Figures 3, 5); lobes narrow, of subequal length 104 long, ventral lobe bare, arising near base of dorsal lobe, apical lobe with several terminal setae. See generic description above for further details.

PUPA ($n=4.3$ exuviae)

Hyaline to very pale yellow with darker yellow, medially interrupted, dorsal and ventral transverse apophyses; lateral apophyses darker yellow-brown.

Length 4.4–7.2 mm.

All cephalic and thoracic setae strong, but non-taeniate: frontal setae (Figure 6) 150–250 long; anteprenotal setae: $Maps_1$ 175–260 long, $Maps_2$ 175–260 long, Laps 115–165 long; precorneals approximated and linearly aligned, subequal, 190–210 long; dorsocentrals: Dc_1 25–50 long, Dc_2 12–25 long, Dc_3 33–50 long, De_4 55–75 long; distances Dc_{1-2} 115–125, Dc_{2-3} 120–150, Dc_{3-4} 20–35. Thoracic horn (Figure 7) 310–470 long, broadened medially, somewhat tapered apically, weakly to densely spinose.

Abdominal tergites as in Figure 8; anal lobe as in Figure 9, with inner marginal seta 110–135 long, 74–99 taeniae, up to 600 long, with macrosetae differentiated by being somewhat broader and darker, and much shorter (250 long).

ETYMOLOGY: The specific epithet *capicola* refers to its dwelling in the Cape.

VARIATION: There is substantial size difference between the type specimen, of length 4 mm, and the three exuviae with lengths of 6–7 mm. This is reflected somewhat in the lengths of the thoracic horn which is 50% longer in the exuviae and more densely spinose. The largest pupa also has the anal lobe with larger and more numerous subapical spines, and generally darker apophyses. Setal lengths also vary in like manner. These mensural differences are considered, *prima facie*, to represent allometric differences, perhaps associated with different developmental conditions, such as temperature (McKie & Cranston 2005).

PHYLOGENETIC RELATIONSHIPS

Elpiscladius gen. nov. evidently belongs in a group of genera centered on *Brillia* Kieffer (the Brillia-group of Sæther & Wang 1992; Cranston 2000), based on the adult male having a strongly setose body, setose wing membrane with R-M long and oblique, dorsomedially extended eye, and hypopygium with characteristic digitiform superior volsella and bifurcate gonostylus. The pupa of this group is poorly defined, but the stout, spinose thoracic horn, strongly developed apophyses and subapical macrosetae on a strongly fringed anal lobe conform with many contained taxa. The male resembles that of the Holarctic *Eurycnemus* van der Wulp (Cranston *et al.* 1989; Kobayashi 1998), particularly regarding the separated anteprenotal lobes, lack of tibial comb and lack of anal point. Differences, however, include the short wing membrane setae, the shorter extension of the scutum beyond the anteprenotum, the lack of dorsal anteprenotals, the mid- and posterior tibial spurs being subequal and the lack of pulvilli. In some features, *Elpiscladius* gen. nov. more closely resembles the Australian-Neotropical *Austrobrillia* Freeman and Holarctic *Euryhapsis* Oliver. The pupa of *Elpiscladius* gen. nov. fails to key in Coffman *et al.* (1986) and in Sæther *et al.*'s (2000) key expanded therefrom: problems derive from irreconcilable character conflicts including non-taeniate lateral setae on posterior segments, simple (non-divided) thoracic horn, and presence of only 3 macrosetae on the anal lobe. Nonetheless, *Elpiscladius* gen. nov. has the 'gestalt' of pupa belonging to the Brillia-group. The inner marginal seta of the pupal anal lobe is unusual, having been observed previously only in *Tvetenia* Kieffer, and the Corynoneura-group (*Corynoneura* Winnertz, *Tempisquitoneura* Epler, *Thienemanniella* Kieffer, *Notocladius* Harrison and *Oucouneura* Anderson & Sæther) (Anderson & Sæther 2005). There is no evidence that this feature links *Elpiscladius* gen. nov. to this grouping, and the presence of the seta must be considered homoplasious.

To address the issue of relationships better, a character matrix used by Cranston (2000) to assess the relationships of *Austrobrillia* Freeman, has been extended to include *Elpiscladius* gen. nov. One character was added: the anteprenotal lobe shape, with an attenuated and well-separated state, previously considered to be autapomorphic for *Eurycnemus*, was scored as present also for *Elpiscladius* gen. nov. This matrix (available from Cranston on application) contains all taxa which bear any likely relationships to the Brillia-group, irrespective of which life history stages are known. In addition, taxa postulated to be among the earlier branching lineages in Orthoclaadiinae are represented. *Prodiamesa* Kieffer (Prodiamesinae) was used as outgroup, and the data analysed under parsimony with PAUP* (Swofford 2002). The matrix contains many unknown states for missing semaphoronts, as for example *Elpiscladius* gen. nov. which is unknown as larva or adult female. However, previous studies (Cranston 2000) indicate that inclusion/exclusion of incompletely known taxa does not alter major relationships based

upon the fully known taxa alone. As seems usual with morphological matrices, resultant trees are of low consistency, retention and bootstrap; however, all recover *Elpiscladius* gen. nov. as sister to the clade *Austrobrillia* (*Euryhapsis*+*Eurycnemus*). In turn, this clade is sister to a poorly resolved group containing the remaining Brillia-group (*sensu* Sæther & Wang 1992), including *Brillia*, *Irisobrillia* Oliver, *Neobrillia* Kawai, *Plhudsonia* Sæther, *Tokyobrillia* Kobayashi & Sasa and *Xylotopus* Oliver.

Although the larva of *Elpiscladius* gen. nov. is unknown, its postulated phylogenetic placement allows some speculation as to its likely morphology. The known larvae of this group, which are more homogeneous than the pupae, all have a 4-segmented antenna with squat apical segments, a heavily sclerotised mentum and a mandible with reduced number of teeth.

BIOGEOGRAPHY AND ECOLOGY

In reviewing the biogeography of Afrotropical Chironomidae, Sæther & Ekrem (2003) suggested that a species of *Tokyobrillia* from Usambara, in the Eastern Arc Mountains of Tanzania, which is clearly a close relative to a Japanese congener, evidently was the sole African representative of genera near *Brillia* or *Irisobrillia*. The discovery of *Elpiscladius* gen. nov., however, indicates that there is a wider representation. Although reconstruction of the phylogeny of the Orthoclaadiinae remains tentative, with much homoplasy and uncertainty concerning the details, there is an emerging agreement that the Brillia-group is monophyletic and represents an early branch ('basal', 'primitive'), perhaps forming the sister group to the remaining Orthoclaadiinae (Cranston 2000; Sæther & Wang 1992). Such a placement is substantiated by a multigene molecular phylogeny (Morse & Cranston in prep), although this study utilises a smaller taxon sample. The emerging phylogeny implies an early origination of a differentiated Brillia-group, which combined with the almost global distribution, implies a Pangaean distribution, with subsequent diversification associated with tectonism, including Gondwanan fragmentation. The close association with *Austrobrillia*, known from Australia and the Neotropics, plus two widely distributed Holarctic taxa, provides additional support for early radiation.

An alternative interpretation for the presence of Brillia-group members in southern Africa is that they belong to groups of chironomids that made their way down the mountain spine of Africa after the continent joined Eurasia, with rifting since the Miocene creating semi-continuous suitable habitat for chironomids (Harrison 1992; Harrison & Hynes 1988). Such a scenario was proposed, derived from the phylogeny of essentially northern *Diamesa*, by Willassen & Cranston (1986). As with *Diamesa*, generally taxa that extend from the palaeartic to southern Africa appear to be more recent intruders into Africa in cosmopolitan groups (Sæther & Ekrem 2003), and seemingly with shallow phylogenetic differentiation from their northern relatives.

Elpiscladius gen. nov. has been found in only two mountain streams in the Cape Fold Mountains of the Western Cape. The taxon appears to be rare in that only single exuviae have been found amongst drift net samples accumulated overnight on three separate occasions – thereby comprising less than 1% of the chironomid exuviae collected on each occasion. The clade to which *Elpiscladius* gen. nov. belongs includes both leaf- and wood-miners, and larval associates with cased caddis flies (e.g. Cranston 2000; Kobayashi 1998), and it might be expected that the unknown larva occurs in one of these under-sampled habitats.

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